The replacement cost of housing, the case of the Danish single-family house.

The rising price of single-family houses in Denmark and it's relation to the activity in the construction sector has given renewed interest in the theory of Tobin's q. Prices for single-family houses in Denmark have risen by 153 percent from 1993 to 2007 in real terms, with a particular steep rise from 2003 to 2006. The activity in the construction sector has been increasing too, but with some time lag caused by what seems to be an inelastic supply of new houses. In the long run, house prices will be determined by the replacement cost of houses, e.g. the cost of constructing a similar house including the cost of land. This can be used as a guide as to how much prices are to fall, in order to bring them back to the fundamental value. This paper presents a calculation of the value of Tobin's q for single-family houses in Denmark from 1968 to 2008. It shows that the value of Tobin's q has risen by around 40 percent from 2003 to 2006, caused by increasing house prices. This was not a sustainable development, and prices and the value of Tobin's q are now falling.

Keywords: Tobin's q, Single-family houses, Price, Construction

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Introduction

The focus of this article is the price development of Danish single-family houses. They constitute a large part of the Danish housing mass, as of 2008 there were 1,076,634 single-family houses, 96 percent of these were owner occupied according to Statistics Denmark (Statistics Denmark, http://www.statistikbanken.dk/, table BOL33). The total Danish housing stock was 2,710,297 dwellings in 2008, so the single-family house accounts for 40 percent of housing in Denmark.

The Danish single-family house is also chosen as a case because statistics for price and construction are available for a long time span. This enables us to analyse both price booms and price busts, which is especially relevant in the current economic situation.

Theory

In an economy with access to land, house prices must converge towards their replacement cost in the long run (Albrecht & Deichmann Haagerup, 2008, p. 120). In other words, if it is possible to build new houses, prices of old houses should not be able to overshoot the cost of constructing a new house including the cost of land in the long run. This formulation borrows on a formulation used in DiPasquale & Wheaton's book from 1996 (DiPasquale & Wheaton, 1996, p. 6), and is in fact a formulation of the value of Tobin's q in relation to housing.

Tobin's q for housing can be written as follows:

$$\text{Tobin's q} = \frac{\text{Market price of existing housing}}{\text{Construction cost plus land cost for new housing}}$$

This relationship is also an expression of the profit for a developer. If the market price of a house for example is 3 million DKK, but a similar house with a similar location only costs 2 million DKK to build (including the cost of land) the developer makes a profit of 1 million DKK on that specific building project.

Every building project has its own unique Tobin's q, but because it takes time from the decision to build is made until the house is ready for sale, there is a time lag. Therefore Tobin's q should be taken as an expression for the expected profit of the building project. A guess would be that it takes around one year to build a single-family house. Therefore the supply-elasticity is never the same in the short run at in the long run. But even in the short run there can be differences in how responsive developers are to price changes.

The difference between an elastic market and an inelastic market can be shown by a two diagram model used by Malpezzi & Wachter (2005) and found in Appendix 1. Because of the increased volatility in house prices from an inelastic supply, an elastic supply of new houses is desirable. An elastic supply of new houses insures that an increased demand of new houses can be met without the appearance of a large house price bubble.

Empirics

Statistically a time series for Tobin's q can be constructed using the price index of Danish single-family houses as nominator, and an index of the cost in the construction sector as denominator.

The price index of Danish single-family houses can be seen below in both real and nominal prices. The real prices are obtained by deflating with the consumer price index (CPI) and both data series are obtained from Statistics Denmark. The price index of single-family houses is made up by all traded houses that year. The price of each house is weighed by the house's specific tax valuation (Statistics Denmark, Label: Price index for traded houses), to take differences in the quality of the trades houses into account.
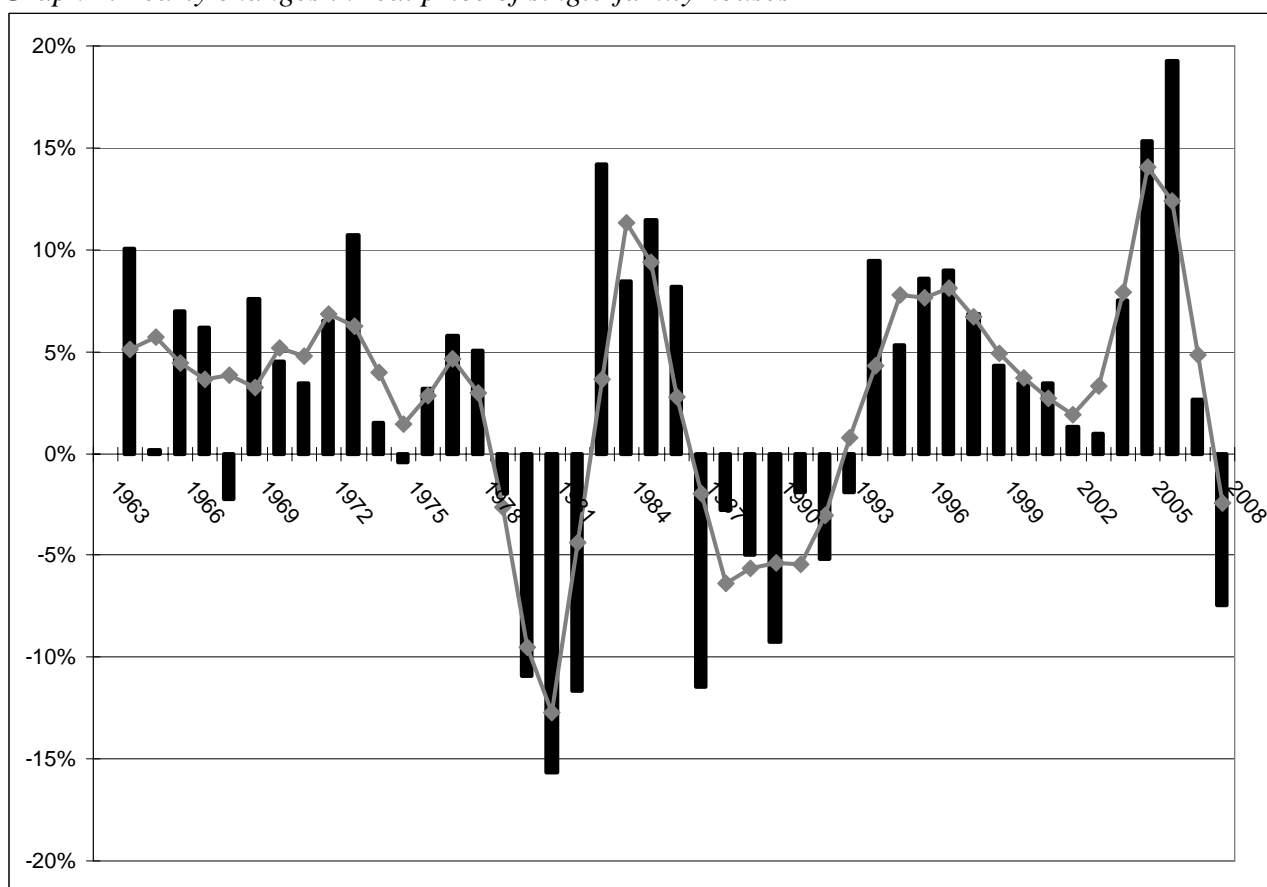
Graph 1. Price index of single-family houses
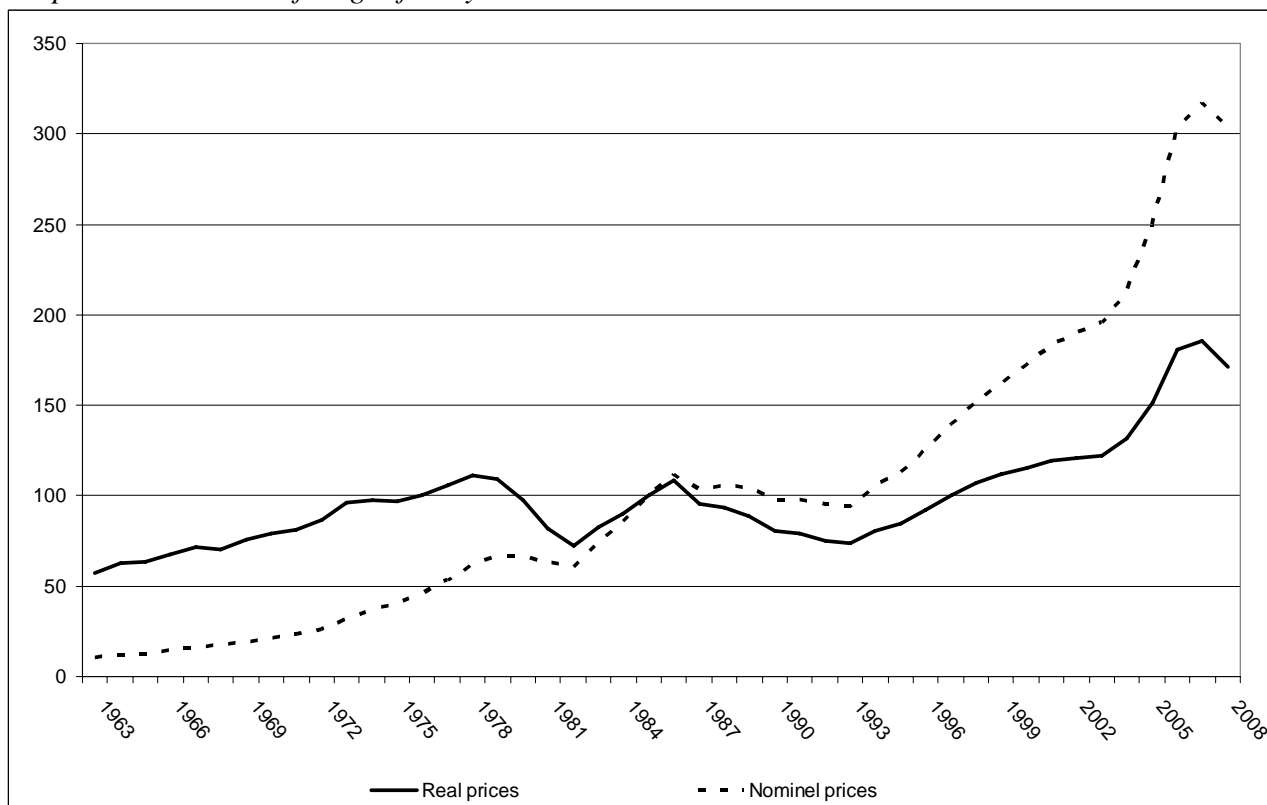
Source: Statistics Denmark and own calculations (www.statistikbanken, table EJEN5 & PRIS6)

When looking at the developments in real prices from 1963 there are three noticeable peaks, the first in 1978, the second in 1986 and the third in 2007. Another way to analyse the prices is to look at year to year changes in real prices, shown in the graph below.

Graph 2. Yearly changes in real price of single-family houses

Source: Statistics Denmark and own calculations (www.statistikbanken, table EJEN5 & PRIS6)

This graph shows the yearly real change in house prices (column) and a 3-year mowing average of the yearly real change in house prices (gray line). It also unveils six different periods, all shown in table 1.

Table 1. Price booms and price busts for Danish single-family houses (real prices)

Period	Years	Total increase	Average yearly increase
1	1963-1978	94%	4.5%
2	1978-1982	-35%	-10.2%
3	1982-1986	49%	10.5%
4	1986-1993	-32%	-5.4%
5	1993-2007	153%	6.8%
6	2008-	-7.5%	-7.5%
	1963-2007	223%	2.7%
	1963-2008	199%	2.5%

Source: Statistics Denmark and own calculations (www.statistikbanken, table EJEN5 & PRIS6)

In the first period from 1963 to 1978 the prices has generally been rising, even though the first oil price chock dampened the increase and gave a small negative development in 1975.

The second oil price chock marks the beginning of period 2 from 1978 to 1982 with an average yearly decrease in real house prices of 10.2 percent, partly brought about by a yearly inflation of 10 to 12 percent. But even nominal prices for single-family houses were falling from 1980 to 1982.

A shift from a floating to a fixed exchange rate of the Danish Krone towards the Deutsche Mark stopped the rising inflation and brought down real interest rates in 1982 and the following years. This decrease in interest rate brought down the monthly repayments on the mortgage on a owner occupied house, and resulted in rising prices in the years 1982-1986, here denominated the third period.

A lower tax relief on interest payments in 1987 meant a higher user cost of owner occupied houses and the number of foreclosures doubled from 1986 to 1988 (Albrecht & Deichmann Haagerup, 2008, p. 34). Real prices fell yearly by 5.4 percent in the fourth period from 1986 to 1993.

A fiscal expansion in 1993 and a generally lower price of credit (Hansen et al. (2003) p. 66) started the rise in house prices in the fifth period. Among other things introduction of new loan types in 2001 and 2003 gave rise to large increases in real prices during the years 2003-2006. In 2007 house prices peaked, but the price increase lost momentum, and in 2008 prices for single-family houses have fallen by 7.5 percent.

Graph 3. Cost index and consumer price index
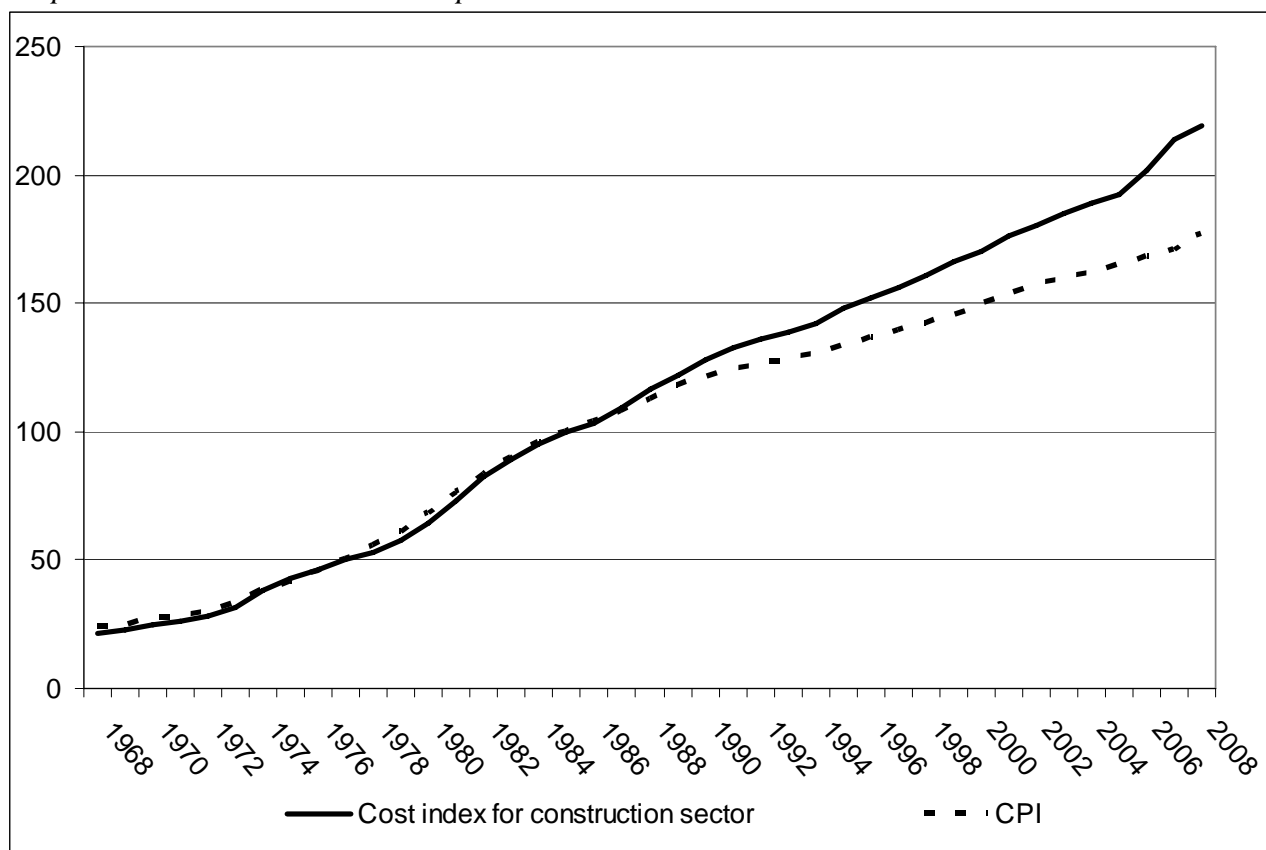
Source: Statistics Denmark and own calculations (www.statistikbanken, table BYG5 & PRIS6)

The Danish Reguleringsindeks for boligbyggeri, enfamiliehuse (cost index for construction sector, single-family houses) is made by Statistics Denmark and is available back to the year 1968. It is

made up by an index for labour such as carpentry and masonry and an index for materials such as foundation, shell and windows (Statistics Denmark, Label: Cost index for construction sector). These two indexes are weighed to represent an average house, and during the years from 1968 to today, the weight have gone from labour to materials.

From 1968 to about 1980 the cost index for the construction sector followed the consumer price index, but from 1980 and onwards the cost index for the construction sector have risen faster than the consumer price index, with an yearly increase about 5 percent in 2006 and 2007.

With both the price index of single-family houses and the appropriate construction cost index it is possible to construct a time series for Tobin's Q. Of course, when dividing two indexes with each other, the scale of the new index becomes arbitrary. As both the index for house prices and construction cost are equal to 100 in the year 1985, the new index is also equal to one in this year. Another possibility is to adjust the data with the same factor so that it on average (Brøchner Madsen, 2008, p. 374) is equal to 1, which should be its long term value. The data for Tobin's q from 1968-2008 in this paper is equal to 0.97 on average, so adjustment is almost unnecessary and hence not done.

As mentioned above, the calculation of Tobin's q should include the cost of land in the denominator. However, there are several complications the first being the poor quality of the price index for building lots. This price index only covers actually traded lots, and this is a problem as new lots, which are mostly located in the outskirts of a city, has a lower value than lots with houses in the city centre. But as these lots with houses are not traded as lots, there is a negative bias in the price index (Skat: http://www.skat.dk/SKAT.aspx?oId=400338&vId=0&i=2#i400338 , a graph of the price index of lots below 2,000 square meters can be found in appendix 2). A second problem is the weight the cost of the lot should have in the denominator of Tobin's q. A guess would be 25 percent, but this would wary according to geographical location due to differences in land prices. For these reasons, the price of the building lot is not included in this calculation of Tobin's q.

Graph 4. Tobin's q for Danish single-family houses
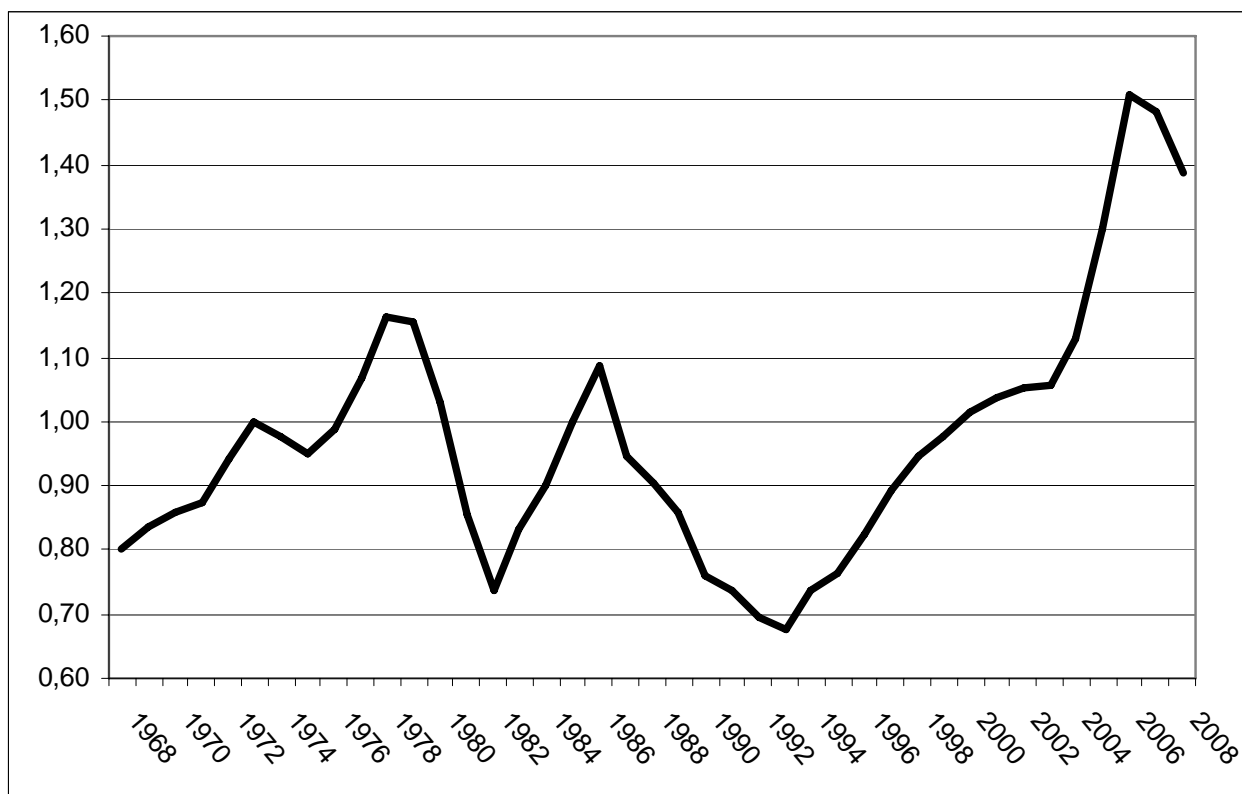
Source: Albrecht, K. H. & Deichmann Haagerup, C. 2008 and own calculations

The same three peaks as in graph 1 spring into mind when looking at the above graph for Tobin's q. The most interesting development however is the uninterrupted increase from 1993 to 2006, where the value of Tobin's q rose from 0.68 to 1.51. In 2007 Tobin's q fell to a value of 1.48, and continued to fall in 2008 to a value of 1.39.

As the value of Tobin's q is a proxy of how profitable it is for developers to construct and sell new houses, there should be a relationship between the level or trend of Tobin's q and the activity in the construction sector, provided that municipalities and other landowners subdivide and sell new building lots for development.

*Graph 5. Number of starts, construction of single-family houses, private developers*
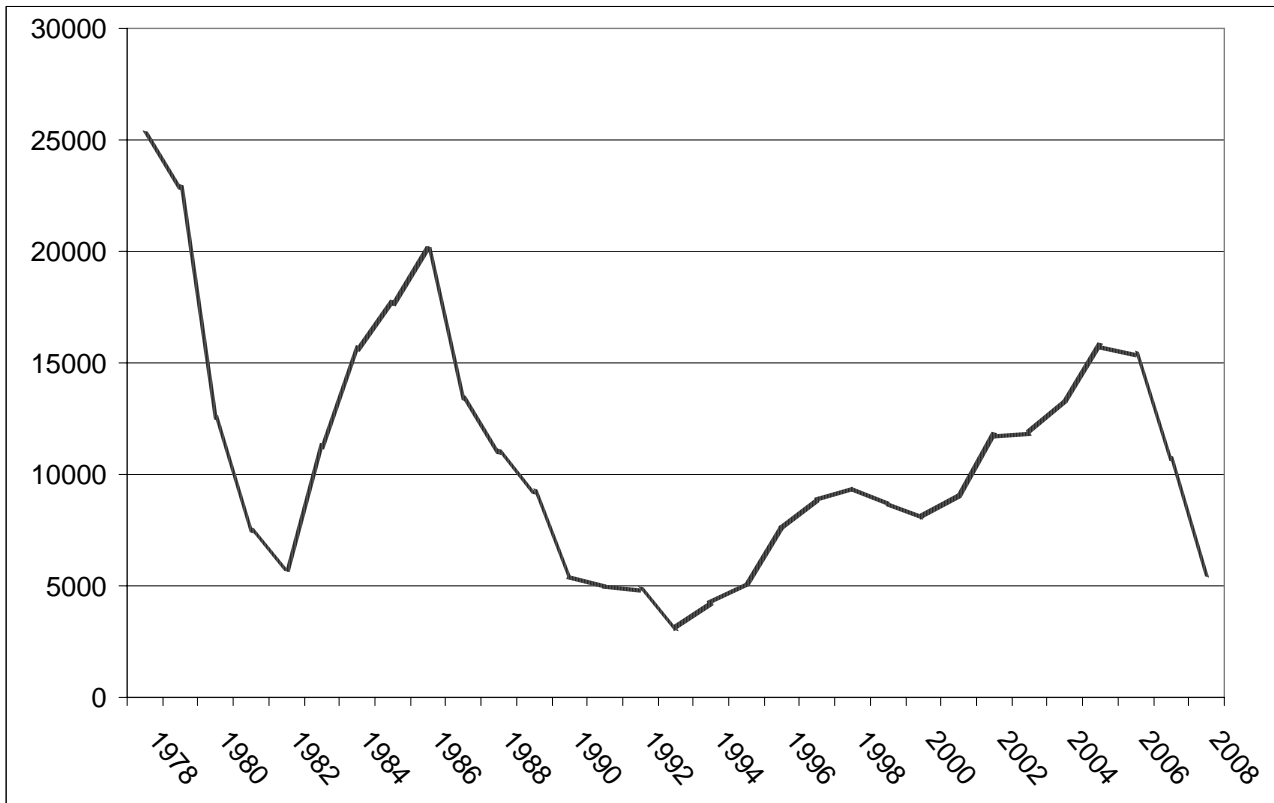
Source: Statistics Denmark, Statistical News, Construction and Housing, various volumes

To avoid interference from government construction, only the number of houses build by private developers is chosen. It is assumed that private developers respond the strongest to changes in profitability and therefore changes in Tobin's q, while government construction or construction aided by government grants is unaffected by changes in Tobin's q. Unfortunately Statistics Denmark only has this time series back until 1978. It shows a large variation in the activity in the construction sector, some years less than 5,000 houses were build, but in 1978 25,000 houses were build, and in both the years 2005 and 2006 more than 15,000 houses were build each year. The number for 2008 is 5,506 houses.

The relationship between Tobin's q and construction is clear if the two time series are presented in the same graph.

Graph 6. Tobin's q and construction of single-family houses
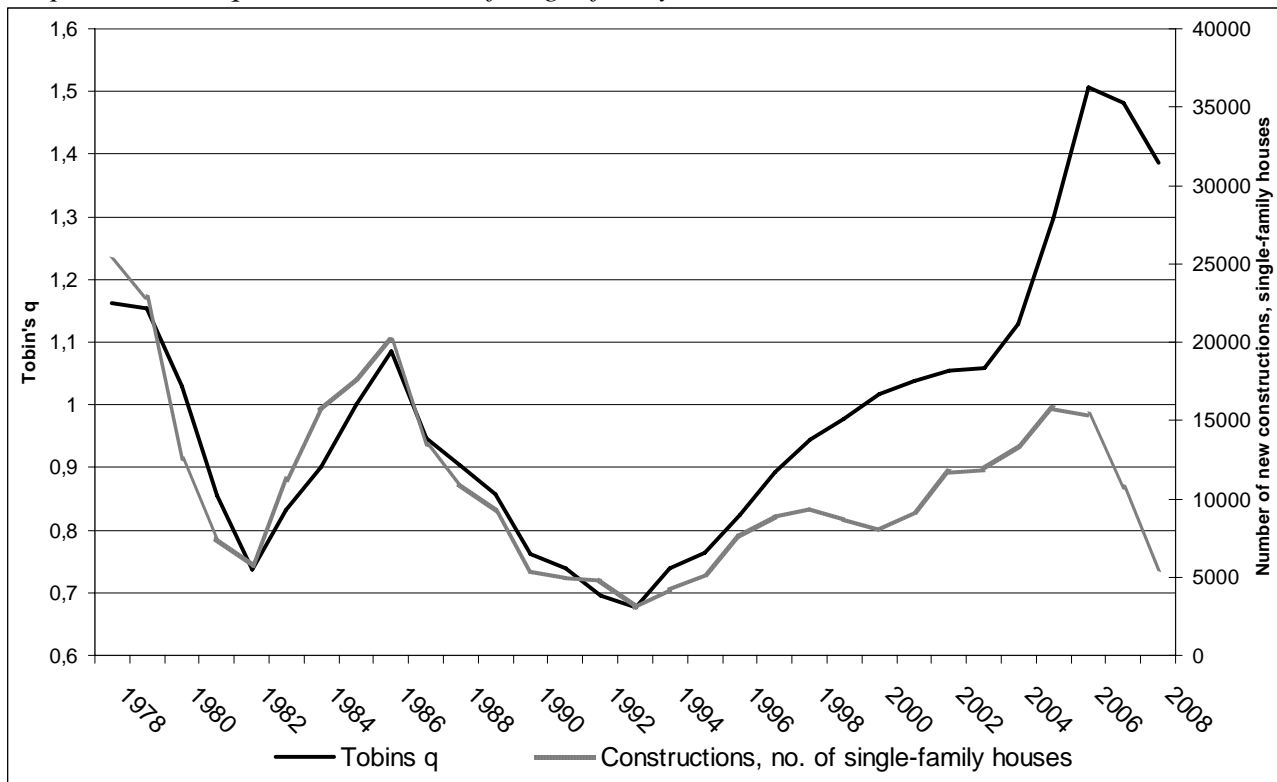
Source: Albrecht, K. H. & Deichmann Haagerup, C. 2008 and own calculations and Statistics Denmark, Statistical News, Construction and Housing, various volumes

The trend in both the value of Tobin's q and construction coincide from 1978 to 1998, but already in 1997 the growth in the activity in the construction sector slowed down indicating an inelastic supply. In 1998 a fiscal contraction lowers the activity in the construction sector the following years, even though the value of Tobin's q was still rising. This lasts until 2001, where the number of new houses rises again. The next turn is in 2007 where the number of newly build houses decreases from around 15,000 in both 2005 and 2006, to 10,670 in 2007. This happens at the same time as a decrease in the value of Tobin's q from 1.51 in 2006 to 1.48 in 2007 and lastly 1.39 in 2008.

Implications

How low should the value of Tobin's q go before the trend of decreasing real house prices will stop?

Answering this question is not without complications, and there are many different approaches. The approach in this paper is to relate the real house prices to the fundamental value of houses. In the long run, the price of houses will always converge towards it's fundamental value, given by the replacement cost of houses, and indeed, looking at graph 6, the is a tendency of Tobin's q to fluctuate around a long run level of 1.

This advocates that the level of Tobin's q should converge towards a value of 1, and looking at the experience from former house price downturns, perhaps to a value lower than 1, meaning a undershooting of the fundamental value in the short run.

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This decrease in the value of Tobin's q can only be brought about by falling nominal prices of Danish single-family houses or rising construction cost or both. Looking at graph 1 and 3 it is clear that nominal prices of Danish single-family houses has been decreasing and the construction cost index is still increasing.

From the third quarter of 2007 to the third quarter of 2008, the nominal price of single-family houses in Denmark has fallen by 5 percent. If a yearly price fall of 5 percent is used for building a scenario of the future, and the construction cost index continues to rise by 2 percent pro anno, Tobin's q will reach a value of around 1 by 2013. This implies a nominal price fall for single-family houses of 23 percent before Tobin's q reaches a value of 1.

From the fourth quarter of 2007 to the fourth quarter of 2008, nominal prices have fallen by around 10 percent. If this yearly nominal price fall of 10 percent continues to be the case in future years, Tobin's q will reach a value of 1 already in 2011. This implies a nominal price fall of 28 percent before Tobin's q reaches a value of 1.

Graph 7. Possible scenarios for Tobin's q depending on future house price falls
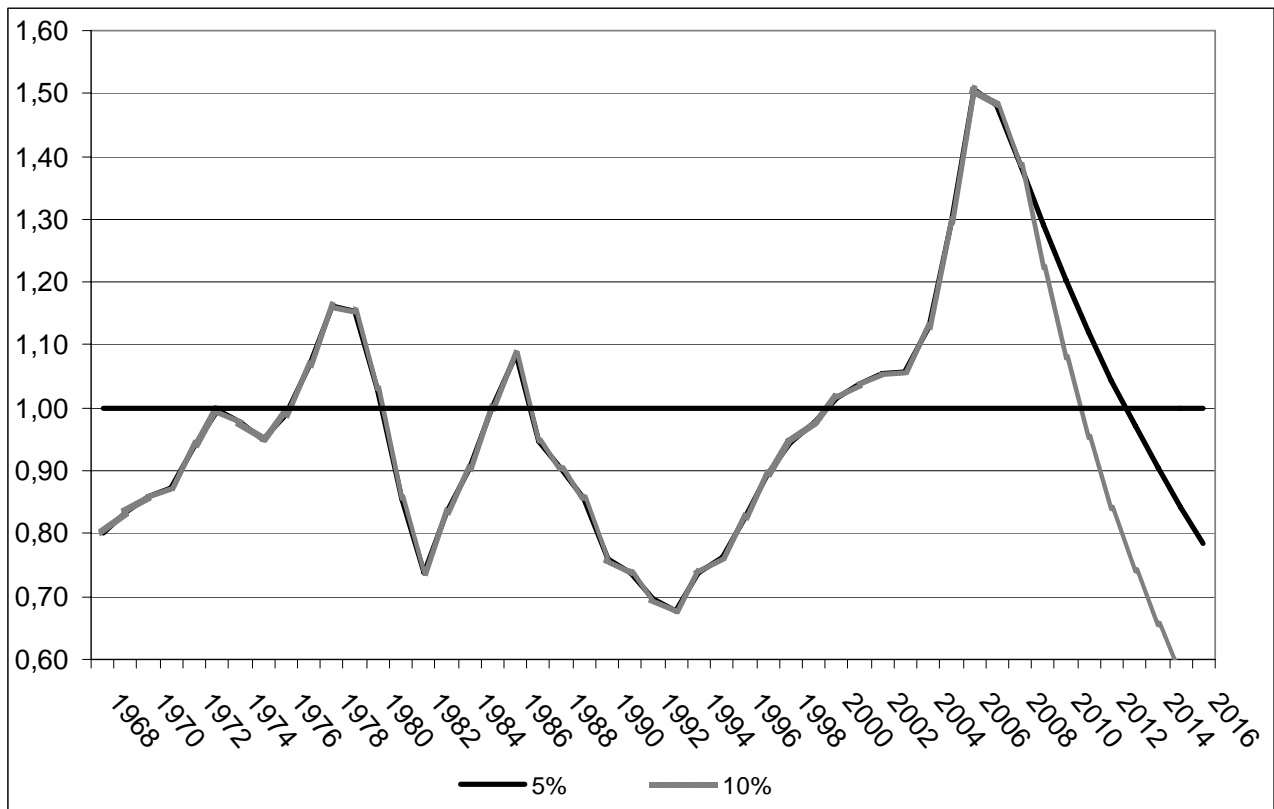
Source: Albrecht, K. H. & Deichmann Haagerup, C. 2008 and own calculations

This is all complicated by the fact that official statistics are lagging behind, and that the quality of more up-to-date unofficial statistics, for instance from real estate brokers and mortgage credit institutions, are often of a lower quality.

Conclusion

In the long run the price of houses should be given by the replacement cost of houses. In a competitive market with access to land, any deviation would result in either construction or no construction (resulting in depreciation of the existing housing stock). How responsive developers are to changes in price depends on their short run supply elasticity.

During the period from 1968 to 2008 real prices of Danish single-family houses have risen by 2.5 percent on a yearly, but during the years 1993-2007 the average yearly increase was 6.8 percent and in 2006 prices rose by 19.3 percent, pushing the value of Tobin's q to a all time high of 1.51 . This was not a sustainable development and prices fell by 7.5 percent in 2008. Bringing the value of Tobin's q back to its fundamental value of 1 involve a nominal price fall of 23 to 28 percent from the current level, depending on how fast the downward adjustment occurs. Whether the recent years overshooting of the fundamental level of Tobin's q will imply undershooting in the coming years still needs to be seen. But an adjustment down to the fundamental level of 1 seems inevitable.

Further research

Extending this analysis to other countries would be of great interest even though the necessary data on prices and construction cost is not always available.

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Appendix 1

An elastic supply of new houses ensures that the short-run supply curve and the long-run supply curve are not very different.

Diagram A1. Demand chock with elastic supply
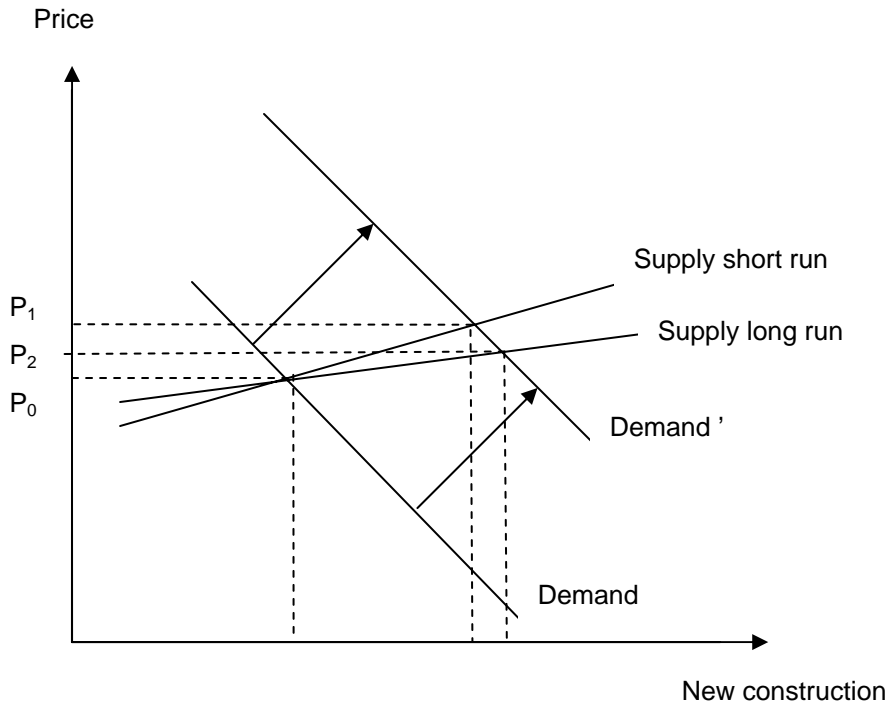
Price

Source: Malpezzi & Wachter (2005) p. 153

Increased demand for housing shifts the demand curve from Demand to Demand '. This leads to an initial price jump from P_0 to P_1 where prices in the short run overshoots it long run future level, but only by very little. In the next period prices fall to its new long run level and the adjustment is complete. The important thing to note is that from period 0 to period 1 the number of new constructions increases almost to its new long run level for period 2, and only a small part of the adjustment from period 0 to period 1 is done via prices. If the supply of new housing was inelastic the adjustment would look a lot different, as shown in the next diagram.

Diagram A2. Demand chock with inelastic supply
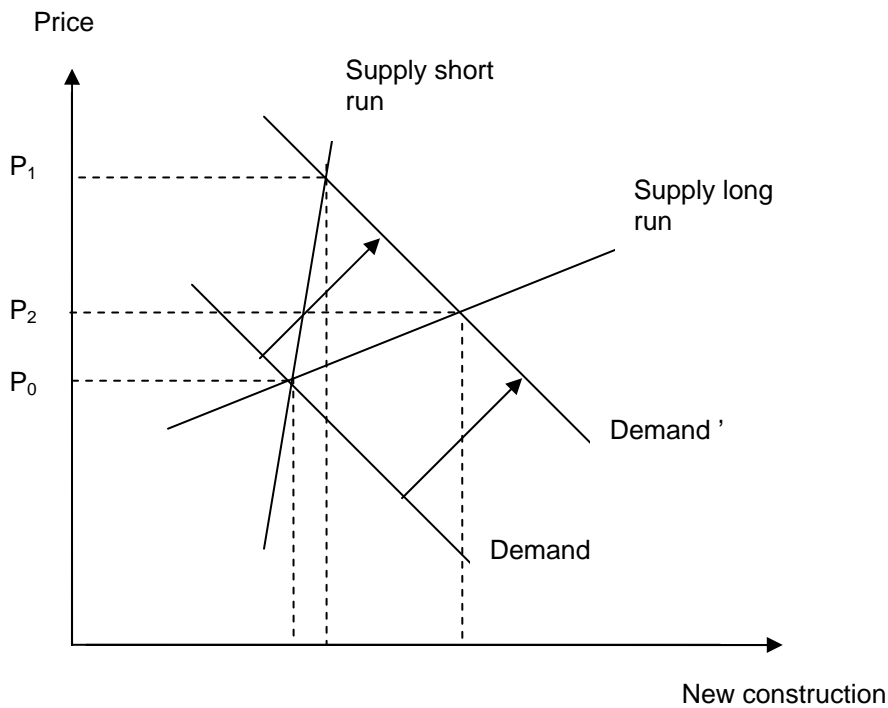
Source: Malpezzi & Wachter (2005) p. 153

An inelastic supply in the short run gives a large difference between the short run supply curve and the long run supply curve. Increased demand is to a large extend not met by increased new construction, and this leads to prices that overshoot their new long run level to a large extend. Not until period 2 is the supply of new housing able to increase significantly.

Appendix 2

Graph A1. Price index of lots below 2,000 square meters

Source: Statistics Denmark and own calculations (www.statistikbanken, table EJEN5 & PRIS6)